MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2018/2019

DET5088 – ANALOG ELECTRONICS 3

(Diploma in Electronic Engineering)

14 MARCH 2019
2:30 PM –4:30 PM
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **7** pages excluding the cover page.
2. Answer **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the answer booklet provided.

QUESTION 1 [20 marks]

(a) Define the characteristics of an ideal operation amplifier.

(6 marks)

(b) Draw an operational amplifier symbol, which shows its internal configuration with labelling.

(4 marks)

(c) Explain the functions of the following filters:

(i) Low Pass Filter

(2 marks)

(ii) High Pass Filter

(2 marks)

(iii) Band Pass Filter

(2 marks)

(iv) Band Reject Filter

(2 marks)

(v) All Pass Filter

(2 marks)

Continued ...

QUESTION 2 [20 marks]

(a) State the 4 operational amplifier characteristics that add error components to the DC output voltage.

(4 marks)

(b) Sketch an over voltage protection circuit. Explain the operation of the circuit.

(10 marks)

(c) Explain the Barkhausen Criterion used in designing an oscillator.

(3 marks)

(d) Sketch an Inverting Schmitt Trigger Comparator and a Non- Inverting Schmitt Trigger Comparator.

(3 marks)

Continued ...

QUESTION 3 [20 marks]

(a) Calculate as well as plot the input signals (V_1 & V_2) and output signal (V_{out}) for a summing amplifier in Figure 1 , given $V_1 = -0.5\ V\ DC$ and $V_2 = 0.5\ V$ peak-to-peak sinusoidal.

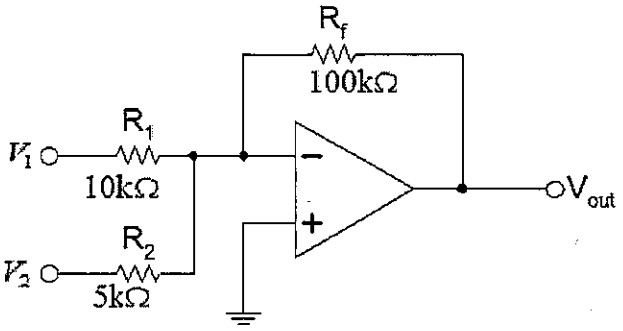


Figure 1

(7 marks)

(b) A difference amplifier in Figure 2 is connected to $V_1 = 500\ mV$ and $V_2 = 880\ mV$. Calculate the output voltage.

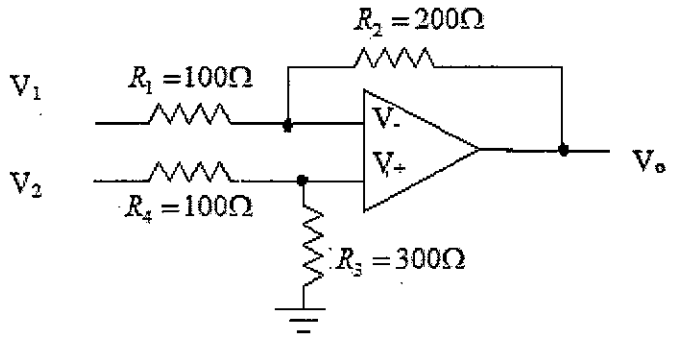


Figure 2

(3 marks)

Continued ...

(c) Given the practical op-amp circuit in Figure 3 has the parameters: $V_{IO} = 10 \ \ mV$, $I_{IO} = 10 \ \ nA$ and $I_B = 100 \ \ nA$.

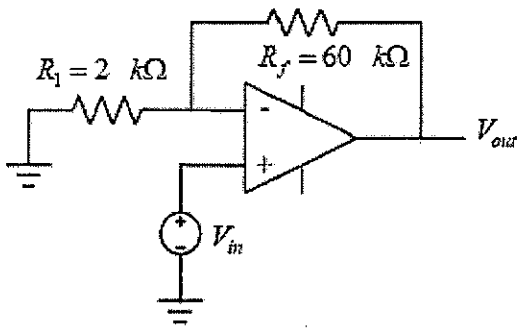


Figure 3

Calculate the:

(i) V_{out} influence by Input Bias Current

(2.5 marks)

(ii) V_{out} influence by Input Offset Current

(2.5 marks)

(iii) V_{out} influence by Input Offset Voltage

(2.5 marks)

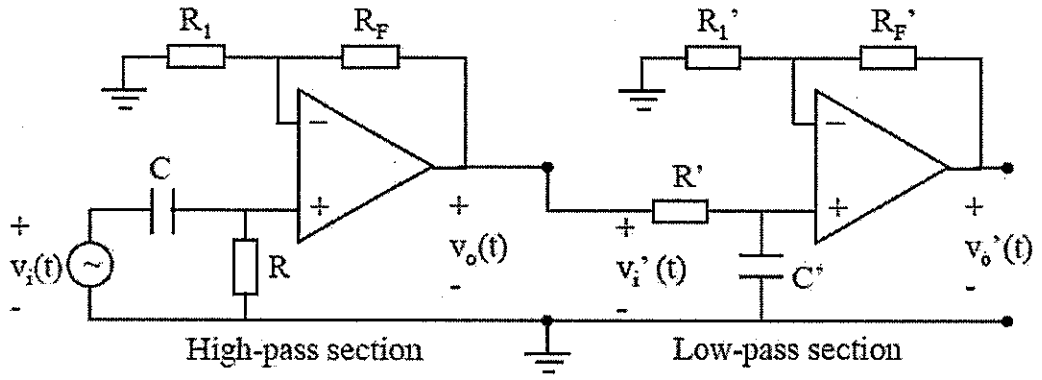
(iv) Total Output Offset Voltage

(2.5 marks)

Continued ...

QUESTION 4 [20 marks]

Given the band pass filter in Figure 4, which has a constant band pass gain of $f_c = 10\ \ kHz$, BW= 100 kHz and $K_{PB} = 4$ with 1^{st} order Low Pass Filter and a 1^{st} order High Pass Filter. Assume $R_F = R_F' = 10\ \ k\Omega, C = C' = 10\ \ nF$ and $R_1 = R_1'$, design the filter and find the quality factor (Q) value.



$$f_L = \frac{1}{2\pi RC} \qquad f_H = \frac{1}{2\pi R' C'}$$

$$K_{HP} = 1 + \frac{R_F}{R_1} \qquad K_{LP} = 1 + \frac{R_F'}{R_1'}$$

Figure 4

(20 marks)

Continued ...

QUESTION 5 [20 marks]

(a) A voltage regulator has a 30 V output when there is no load $I_L = 0 \ \ A$. When there is a full-load current of 18 mA, the output voltage is 28.9 V. Express the voltage regulation as a percentage change from no-load to full-load and also as a percentage change for each mA change in the load current.

(6 marks)

(b) Given a Wien Bridge Oscillator in Figure 5.

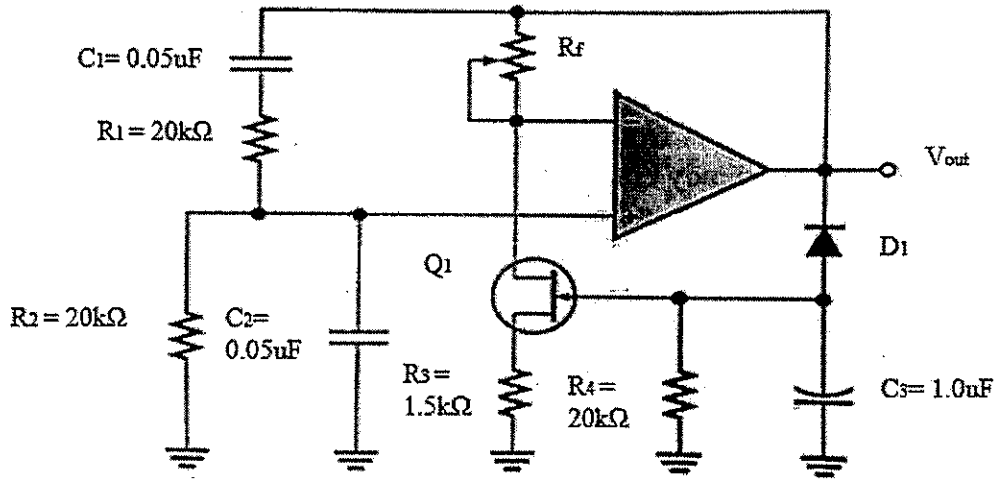


Figure 5

Find the following:

(i) Resonant frequency, fr.

(1 mark)

(ii) Potentiometer Rf value if the internal drain source resistance r'_{ds} of the JFET is 800Ω when oscillations are stable.

(6 marks)

Continued ...

(c) A Schmitt Trigger Comparator is shown in Figure 6.

(i) Determine whether it is a Non-Inverting Schmitt Trigger Comparator or an Inverting Schmitt Trigger Comparator.

(1 mark)

(ii) Provide reason for your justification.

(2 marks)

(iii) Calculate the V_{UTP} and V_{LTP} assuming that $+V_{sat(\max)} = +5\ V$ and $-V_{sat(\max)} = -5\ V$.

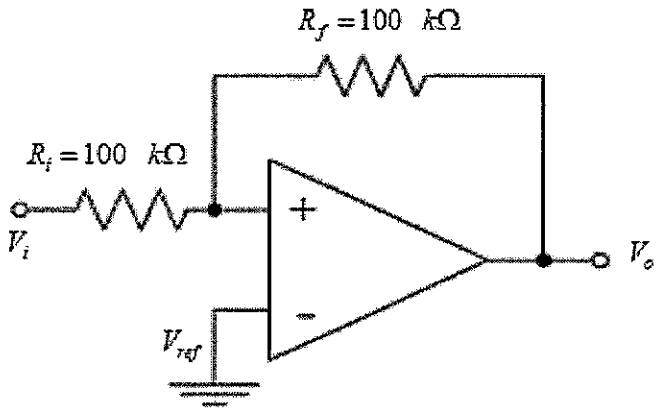


Figure 6

(4 marks)

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